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**Shattering the Crystal Goblet: Seeking a Pedagogy of Visuality in Post-
Typographic Expository Texts**

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Abstract

This article synthesizes diverse theoretical perspectives toward developing a pedagogy that addresses the visibility of digital texts. To frame those perspectives and their implications, I use a well-known analogy that Beatrice Warde introduced to typographers in the 1930s: drinking wine from a golden cup or a crystal goblet. I briefly review the theory and research related to visual aspects of texts, generating pedagogical perspectives from several prominent theories and perspectives. I then discuss, illustrated with a few examples, how these pedagogical perspectives might be instantiated in curriculum and instruction and the issues and challenges of doing so. I argue that researchers have done little to directly address those challenges and issues in ways that inform practitioners.

Keywords: digital texts, visibility, theory to practice

A classic in the literature about typography and printing, still used and often quoted, is Beatrice Warde's 1930 essay entitled "The Crystal Goblet" (republished in 1955: <http://gmunch.home.pipeline.com/typo-L/misc/ward.htm>). Her essay was the published version of an invited talk to the British Typographers Guild in London with the original title "Printing Should be Invisible." In her speech and subsequent essay, she introduced an analogy, asking her audience to consider drinking wine from a gold cup or from a crystal goblet. The wine represented textual meaning, and the gold cup and crystal goblet represented alternative views of how a text's visual appearance was positioned in relation to its meaning. Her point was that wine is better when it is served in a transparent vessel. Likewise, the visual representation of a text should be transparent to avoid drawing readers' attention away from its meaning. A gold cup may be intrinsically more impressive, ostentatiously drawing attention to itself, but it is not as well suited to gaining the full enjoyment of drinking wine when compared to a plain crystal goblet. Similarly, a text using an ornate, even artistically pleasing, font draws attention to itself, but may detract from a reader's access to meaning. In her view, printed text, at its core, is displayed essentially to enable readers to look through, not at, its visual representation to derive meaning—the transparent crystal goblet that contains the wine of meaning.

The longevity of Warde's analogy is likely due to its memorable imagery for an underlying tension that exists in the construction of virtually all written texts. The visual elements interact with and must, through that interaction, ultimately serve a communicative purpose, not oppose it. That idea, expressed succinctly in Warde's analogy, serves as a unifying theme in this article. My aim is to update and extend her analogy into the present post-typographical era where digital texts, particularly on the Internet, predominate, comprising a textual world that she could hardly have imagined.

But, as an education researcher I am invested in connecting theory and research to practice; indeed, personally, it has become a more conscious obligation in recent years. So, my larger purpose is to seek pedagogical principles that might be useful to developing curriculum and instruction addressing digital texts and their visual nature. As a preview of that aim, the underlying intent of Warde's analogy might be regarded as a foundational pedagogical directive that transcends textual media. As she wrote, "the first thing [that must be asked is] not 'How shall it look?' but 'What must it do?' (cited and quoted in McVarish, 2010, p. 289). That maxim might be the starting point for any informed pedagogy about digital texts, especially because "how it shall look" is a deeper, more encompassing, and more challenging question today than in Warde's era. In the remainder of this article, I endeavor to extract more specific pedagogical principles from relevant theories and empirical research, to identify challenges in applying them, to provide a few instructional examples, and to suggest research that might be more pedagogically pertinent. Because formal education revolves around expository texts, I limit attention here to expository, or informational, texts, which are also prominent in the workplace and in the realm of informed citizenship.

MY PERSPECTIVE

My perspective is informed by a career that began as a fifth-grade teacher in the early 1970s when the two Steve's (Jobs and Wozniak) were still in a garage tinkering with electronic components that eventually became the first Apple computer. By the beginning of the next decade I used the second-generation Apple to type my dissertation investigating how a computerized text might provide assistance to enhance readers' comprehension. Being a financially challenged doctoral student, I wrote the crude program that displayed the text on the screen myself. Nonetheless, I had to hire a professional typist who used a typewriter to prepare

the final version of my dissertation because computer printers could then only make letters out of dots-- readable, but equivalent, using Warde's analogy, to a chipped crystal goblet. My dissertation, which was eventually published (Reinking & Schreiner, 1985; followed by a partial replication, Reinking 1988), initiated my keen interest in the differences between printed and electronic texts, including their respective affordances for managing the visual display. That interest expanded when, as a new professor at Rutgers University, the first Apple Macintosh was released. I vividly recall my colleagues and I huddled around this revolutionary new computer most notably evidenced by what then seemed like its magical visual displays.

As this brief personal history suggests, my career has closely paralleled the historically unprecedented and rapid evolution of digital texts, their remarkable functionality and accessibility, and their essential visuality. Yet, as others have also noted, the literacy curriculum and instruction has lagged far behind these developments, in many instances remaining essentially unchanged. New technologies and the use of the Internet can be seen in many classrooms, but they are frequently used haphazardly more for their own sake than as means for addressing specific curricular or instructional goals related to new aspects of literacy (see Hutchison & Reinking, 2011). As will become evident subsequently in this article, I lay much of the blame for that state of affairs at my own feet, and that of my literacy research colleagues. We have been too theoretical, too misguided in the focus and conduct of our research, and too cavalier about expecting educators to figure out on their own how to make use of our work. Thus, this article is partially motivated by a personal sense of penance.

THEORIES AND THEIR PEDAGOGICAL IMPLICATIONS

There is a long history of theorizing about the visual appearance of texts and how it might affect ease of reading, motivation, and comprehension. Early work was consistent with Beatrice

Warde's analogy, focusing on variations in typographic features. In 1963, Miles Tinker, also known for his influential book on reading difficulties with Guy Bond and his eye movement studies, published a definitive book entitled *Legibility of Print*. It summarized his and others' decades of research investigating factors such as font, color, illumination, print surface, and spacing, comprising the concept of "legibility," which he proposed as a term that complemented "readability." Although he often found statistically significant effects when these textual features were varied, many of the variations were extreme with little practical significance for the design of texts and virtually no implications for instruction. It was a simpler time of raw empiricism and laboratory-like psychological studies.

Although some researchers continued in that vein, the next two decades saw more interest among reading researchers in what were often termed graphic aids or ancillary aids, because they were viewed as subservient to the prose in which they appeared. These aids included pictures, diagrams, maps, tables, and figures in expository texts as aids to understanding. The focus was on academic learning and how readers' comprehension of mainly textbooks might be enhanced through graphic aids. There was also some interest in how readers might be taught to make better use of graphic aids as they read and studied academic texts (e.g., Reinking, 1986; Summers, 1981; Vacca, 1981), although this interest did not typically rise from theory or empirical research. There was also some interest in how readers processed other inherently visual texts, such as airline schedules (e.g., Guthrie, 1988; Guthrie, Britton, & Barker, 1991), but such studies offered little, if any, useful guidance for instruction.

A third period beginning in the late 1980s might be characterized as a great awakening precipitated by a relatively rapid realization, at least on historical scale, that emerging new digital texts changed dramatically the dynamics of disseminating, accessing, and reading textual

information. A key awareness was that the role and function of a text's visual presentation was becoming dynamic and thus more central. Theory and research followed accordingly with considerable attention initially on pitting newer digital texts against conventional printed texts, a line of research that eventually almost disappeared as it became clear that digital texts (mainly the rise of the Internet) and online tools for constructing them (mainly word processing) were here to stay. However, it was a period of rich theorizing about the unique affordances of digital texts that continues to some extent today.

Some of these theories and lines of empirical research suggest perspectives and approaches that have pedagogical implications, although those implications have rarely been considered. They have not been offered as theories of pedagogy and make no such claim. Thus, in their raw form, these theories are effectively silent about pedagogy. And, some are perhaps so purely theoretical and academic that they have virtually no obvious practical application to pedagogy. For those with pedagogical potential, at least some translation is needed. A first step in that translation might be to generate and then synthesize what might be called "pedagogical vectors" that provide broad theory-based principles for pedagogy, in this case related to the visual elements of digital texts. That is the purpose of the next two sections. The final section will attempt to reconnect explicitly with Warde's analogy. A caveat is that the following theories are representative, not exhaustive, and they are greatly simplified.

Dual Coding Hypothesis

Allan Paivio (e.g., 1986; see also <http://www.instructionaldesign.org/theories/dual-coding/>), a cognitive psychologist, proposed that there are two interacting and complementary cognitive systems: verbal and non-verbal. The non-verbal includes imagery. A corollary of this theory is that information coded in both systems is more memorable. Mayer (e.g., 2001), also a

cognitive psychologist, conducted numerous studies testing that corollary in relation to graphical representations in texts. His work added nuance to the general theory, which mostly held in his findings.

Pedagogical perspectives: Combining non-verbal visual representations with verbal prose can increase the memorability of textual information. Thus, attention to the visual elements of a text, either in creating or reading them, exist theoretically on a more equal footing with prose, at least when the goal is retention of content. Accordingly, they deserve appropriate instructional attention in helping students contend with and benefit from them, including students with various needs and abilities.

Distinguishing Media

Gavriel Solomon (1979) proposed a theory for distinguishing among media that communicate information. Until his theory, the distinctions between media were mainly intuitive or defined culturally and linked to their physical properties or technologies. Media, in his theory, could be distinguished based on four factors: symbol systems, technologies, contents, and the situations in which they were considered appropriate and used. The first two factors, symbol systems and technologies, were linked and inherent to a medium; the latter two determined more by cultural convention. A key aspect of his theory was that technologies of some media enabled symbol systems that required more or less effort to extract meaning and information. Similarly, the technologies and symbol systems of some media entailed more or less capability to support, or potentially to supplant, the cognitive processes needed to obtain information from a particular medium. For example, he described a study in which the capability of the film camera to zoom to close-ups could be used to draw attention to important details for learners who were less detailed oriented. Because his theoretical work was on the cusp

of printed and digital media, his examples used existing media such as maps, musical scores, film, and print.

Pedagogical perspectives: Teachers and their students should approach digital texts as a distinct medium with unique symbol systems and technological affordances. Reading and writing digital texts is not a variation or extension of conventional printed texts. An explicit awareness of the unique symbol systems, the technological affordances that enable them, and the way they might be used to facilitate comprehension are necessary to read and construct digital texts effectively. Expansive possibilities for non-verbal, visual elements are central to the symbol systems that can be employed in creating digital texts and thus expand exponentially opportunities to facilitate and support comprehension and learning from textual information.

Dynamic and Interactive Legibility

Daniel and Reinking (1987) extended Tinker's (1963) notion of legibility into the realm of digital texts. In their view, decisions about the visual presentation of printed texts, and thus their "legibility," were essentially a question of how to fill two-dimensional space on a page. In contrast, decisions about digital texts are multi-dimensional in which the space on a screen could be visually layered; thus, they are essentially three-dimensional. But, an additional and even more important dimension is time. That is, authors (and sometimes readers) had to decide when diverse elements of a text would appear and under what circumstances. The latter capability enabled what they called interactive legibility, which included making decisions about when and under what circumstances readers or a computer program would control access to particular segments of text that could be seen on a single surface.

Pedagogical perspectives: The design and creation of digital texts entails complex multi-dimensional decisions far beyond printed texts. For example, texts can be visually layered, represented by the metaphor of a desktop. When and under what circumstances textual elements are presented or made available on a screen are additional dimensions of digital texts. Teachers and their students need to be aware of that complexity and its relevant dimensions; they need opportunities to analyze existing texts along these dimensions; and they need instructional frames and activities to contend with them in constructing digital texts.

Conceptual Differences Between Printed and Digital Texts

In my early work, (e.g., Reinking 1987, 1992, 1998) I used Salomon's (1979) general theory about distinguishing media and extended it specifically to texts. I argued that printed and digital texts were different media, not only broadly on the basis of their symbol systems and technologies, but more specifically because they entailed the following differences:

- Structural (linear hierarchical organization vs. non-linear hypertexts)
- Symbol systems (alphanumeric symbols and static graphics vs. expansive multimedia with dynamic visual representations)
- Interactive capabilities (figurative interactions between textual information and readers' own knowledge requiring well-developed metacognitive skills vs. literal interactions between readers and responsive texts where a text can sense readers' difficulties and inefficiencies and can take appropriate actions to mitigate them, thus supplanting meta-cognitive skills.)
- Control of textual display and reading experience (strategic control in reading static pages exclusively controlled by reader vs. combination of reader, author, or computer

algorithms having dynamic control of visual display and reading experience; see

McEneaney, 2006 for a more detailed theory about this difference.)

- Genres and pragmatic conventions (e.g., books with their tables of contents and alphabetic indexes vs. web sites with words in blue signaling available intertextual links, or popup windows that provide on-demand information such as definitions or illustrations).

I also argued (Reinking, 2001) that these characteristics make digital texts inherently more engaging than printed texts. Specifically, they (a) make reading active rather than passive, (b) easier than harder (e.g., instant access to the meanings of unfamiliar words; see Reinking & Rickman, 1990), (c) more able to meet a variety of psychological and social needs (e.g., blending informational texts with social media; growing a real plant remotely when reading a text about plants), and (d) more amenable to creativity, playfulness, and experimentation (see the subsequent section on Richard Lanham).

Pedagogical perspectives: The obvious technological and visual differences between printed and digital texts are only meaningful in light of a deeper understanding of conceptual differences. Likewise, a pedagogy that focuses only on the visual or technological aspects of digital texts will be superficial, over simplified, and incomplete. Strategic understanding and use of digital texts' visual elements must be embedded in a broader and more nuanced understanding of such conceptual differences. Otherwise, teachers and students are more likely to focus on what can be done visually rather than what should be done to accomplish specific communicative purposes. Further, because the structural and visual dynamics of digital texts and the interaction between these

elements are unique, students may need guidance about how to employ them strategically in ways that invite a heightened metacognitive awareness.

Digital Texts as Visually Rhetorical

Richard Lanham (1993) analyzed printed and digital texts from the standpoint of their rhetorical modes and potentials. A key difference in his analysis was that printed texts—because of the technologies available for producing them and emergent cultural conventions of form and genre (the book being the highest form; see Reinking, 2009)—are grounded in a philosophical rhetoric. That rhetoric essentially establishes an unwritten contract between readers and writers of “perceptual denial” consistent with Warde’s metaphor of the crystal goblet. That is, we look through texts, not at them. Printed texts are silent, static, introspective, and serious. Further, authors are authorities who feel no obligation other than to express their own views and interpretations to readers as strongly and convincingly as they can. A reader’s role is to accurately determine the author’s intent with few convenient or feasible options to oppose the author (e.g., publish a review, letter to the editor, or their own book).

Digital texts, on the other hand, are more naturally driven by a visual rhetoric. They are visually dynamic, interactive (what Barthes, 1974, called writerly, rather than readerly, texts), contentious (readers can more readily and publically challenge authors), and they invite a less-serious, playfulness, and experimentation. If the crystal goblet is an apt metaphor for printed texts, an apt metaphor for digital texts is a carnival funhouse of visual effects and creative innovation, as well as a forum for public dialogue. The increasing interest in infographics is a good example of such creative innovation around visual representation (see:

<http://www.thevisualeverything.com/category/infographic/>). Lanham captured this perspective

when he imagined students invited to create a digital version of Milton’s *Paradise Lost*:

Wouldn't [they] begin to play games with it? A weapon in [their} hands after 2,500 years of pompous pedantry about the Great Books. Hey man, how about some music with this stuff? Let's voice the rascal and see what happens. Add some graphics and graffiti! Print it out in [different fonts] San Francisco for Lucifer and Gothic for God (p. 7).

Pedagogical perspectives: Teachers and students must take a fundamentally different rhetorical stance toward digital texts, shedding many of the assumptions and conventions associated with printed texts. Screens are not pages, which is now an archaic metaphor that exists incongruously with scrolling, a more apt, but even more archaic metaphor. Screens, especially on devices with small screens, are visually contested spaces. Writers are designers in that space where they make rhetorical arguments visually, not disembodied authors arguing philosophically. Making such decisions are less prescribed and less dictated by formal conventions, which encourages thoughtful innovation, creativity, and playfulness. Playland, a conceptual metaphor introduced by Labbo (1996) to describe how young children used computers to create mostly visual texts in school now becomes an apt metaphor for all authors of digital texts and how they might be approached pedagogically.

Illustrating Instructional Texts

That is the title of a short, but often cited, article by Phillippe Duchastel (1978). He was not proposing a theory, but a framework of distinct, but overlapping, purposes for illustrating texts. That he was firmly grounded in the world of print, before the digital era, is evidenced by his division of labor between the author who is the "master of words," and the illustrator who is the "lord of the image" (p. 36). Yet, his scheme still has meaning and potential applicability in a

post-typographic era that he could have little imagined at the time. He identified three main roles of illustrations in informational texts: (a) attentional, which includes motivating a reader and increasing interest of a text; (b) explicative, visually enhancing the understanding of the prose; and (c) retentional (drawing on Paivio, 1986). However, he acknowledged that the real challenge facing designers of instructional texts was orchestrating these overlapping roles.

Pedagogical perspectives. Duchastel's scheme is a simple one, but still applicable to digital texts. It might serve as a workable initial frame for analyzing and designing digital texts as primarily visual entities. His categories are intuitive and might be a springboard for more complex and nuanced analyses among teachers and their students. Because the roles overlap, it leaves room for much discussion about what purpose visual information might serve in a particular text as well as texts with specific explanatory goals such as Wiki How (see: <https://www.wikihow.com/Main-Page>). For example, questions might be addressed about when and why illustrations are essential to such websites? When they are not as crucial for some entries than others? What role the visual information serves? How the illustrations might be better designed?

Anti-reading

Jay Bolter (1991) argued that the essence of reading is a reader's interaction with a text that allows a space to pause and reflect, thus disrupting a natural inclination for perceptual immediacy. Put another way, texts enable reading when they purposefully create conditions that encourage readers to maintain a critical distance from perceptual input. Texts, regardless of the media used to create and read them, that undermine or work against the essence of reading are a form of anti-reading because they pander to a preference for immediate perception without reflection. Novels purposefully written to be page-turners or action movies represent conditions

that invite anti-reading, with virtual reality being the quintessential example of seeking immediate perceptual experience without reflection. Interestingly, as a counterexample, he developed (personal communication) a virtual reality application of buildings that represented major topics in a university catalog and that enabled readers to “fly” to a building, entering it to explore floors (subtopics) and eventually rooms where linguistic information was displayed on walls. Bolter’s view of reading and anti-reading connects to Wardes’ metaphor of the crystal goblet, because it suggests that the visually perceptual, even if it is only imagined, is always subordinate in real reading. But, it provides nuance to that metaphor, going beyond typographic displays and allowing for a panoply of visual elements to play a role in provoking and sustaining reflection, but that always risks becoming anti-reading.

Pedagogical implications. The concept of reading as essentially reflection takes a consideration of texts beyond a debate about the technologies and physical forms of texts. Teachers and students might strive to acquire an understanding of reading and texts that is deeper than the outward appearance of their displays. Books, for example, are essentially texts that are as much, if not more so, cultural artifacts than they are technologies (Lanham, 1993; Reinking, 2009). Yet, it can be argued, and has been (notably, Birkerts, 1994), that books, as the epitome of printed texts, are also more inherently reflective, largely because of the paucity of their options for presenting information visually. They more naturally gravitate toward reading and away from anti-reading because their constituent technologies limit the available symbol systems (Salomon, 1979). That does not mean that digital texts cannot be equally, and even more powerful, reflective artifacts, only that they are more susceptible to visual excesses that may nurture anti-reading. More conscious attention may be needed to preserve the

essence of reading when a visual rhetoric predominates. Such a concern can be manifested in mundanely practical ways. For example, incorporating a video or interactive graphic into a digital text that does not include a pause and replay option works against providing a reflective space. Digital texts, with their wider array of symbols systems, mainly in the realm of the visual, also present greater opportunities to assist learning by supplanting the sometime difficult internal processing necessary to extract information from printed texts. That too, might be weighed in considering the visual representations in digital texts and their use and design. Asking students to find examples of gratuitous visual representations in digital texts, and to justify their examples, would be one way to develop that sensitivity.

Multi-literacies, New Literacies, and Multimodal Communication

These are perspectives, not theories that explain or predict phenomena or unify observable data, despite that they are often presented and cited as theories, theoretical perspectives, or emerging theories. Yet, these overarching terms allude to convincing rhetorical arguments that promote a broader, more encompassing view of literacy and communicative artifacts. Integral to those arguments is that literacy is changing and expanding in a globally connected, multicultural world where digital forms of communication are not only normal, but essential to conceptions of literacy and thus to efforts to understand and develop literacy. The multi-literacies perspective originated with a small group of linguists who met to discuss these issues leading to a published manifesto (New London Group, 1996) frequently cited among literacy researchers. New literacies is a closely related perspective originating with and promoted by literacy researchers. It focuses on the Internet and emphasizes rapid change in what constitutes literacy (see Coiro, Lankshear, Knobel, & Leu, 2008). A unifying idea of both

perspectives is that communication, and thus literacy, is multi-modal including linguistic, audio, spatial, gestural, and visual modes and that digital texts enable all of these modes.

Pedagogical implications: Both multi-literacies and new literacies challenge existing pedagogy that is seen as too narrowly focused on developing decontextualized skills (Multi-literacies) or as not appropriately or adequately addressing digital textual forms, particularly the Internet (New Literacies). They provide a coherent justification for why educators should broaden the scope of literacy and attend specifically to visual and other modes in digital texts. However, although influential to the thinking of literacy researchers and scholars, neither has had an impact on curriculum or instruction in schools (for more than 20 years in the case of multi-literacies), despite endorsements by leading literacy organizations (e.g., International Reading Association, 2009). There is no evidence that schools in general, either through administrative fiat or through teachers' grassroots efforts, are substantively modifying the conventional literacy curriculum or instruction to accommodate and address these new modes. In a subsequent section, I address the reasons for that lack of influence. Suffice it to say here that these perspectives are more useful in arguing that substantially new pedagogies are needed, but they are not accompanied by equal attention to what exactly those new pedagogies might entail, and they are virtually silent on how they might be achieved.

Reading Images

In their book with the same title (subtitled "The Grammar of Visual Design" and in a second edition), Kress (a member of the aforementioned New London Group) and Leeuwen (2006) take a social semiotic view of visual representation, although one that takes a broader view than just texts (e.g., visual artistic artifacts such as paintings). They stated that their book

was aimed to provide “a useable description of major compositional structures which have become established in the course of the history of Western visual semiotics, and to analyse how they are used to produce meaning by contemporary image-makers” (p. 1). They addressed, “what we can do to, or for, each other with visual communication, and with the relations between the makers and viewers of visual texts which this entails” (p. 15).

Pedagogical Implications. There is an unflattering, and perhaps unfair, joke about the sub-discipline of semiotics in linguistics. It goes like this: “What do you get when you cross the Godfather with a semiotician?” Answer: “An offer you don’t understand.” Yet, like most jokes, it contains a grain of truth. For me, and others (e.g., see Thuy, 2017), semiotic perspectives cross a line that separates theories and perspectives having relevance to practice and those where relevance is decidedly unclear, strained or frustratingly obscure (see Dressman, 2016 for another, interesting, but strained, example). Nonetheless, I included a semiotic perspective here mainly to make that point and to suggest that such theories exist; they are interesting and intellectually stimulating, but they offer little insight relevant to practice. On the other hand, some readers may find the previous theories I have included to also be close to or across that line. (But, unfortunately, given that I am writing essentially in a print-based genre, those who disagree have few options to disagree publically, although private communications are welcome: dreinkin@gmail.com). So, a final point to be made in this section is the caveat that theories can only go so far in generating pedagogically useful perspectives that directly inform instruction and that, typically to do so, explicit work must be done to translate them in ways that are helpful to practitioners. The next section takes that assertion a step further.

SYNTHESIZING PEDAGOGICAL VECTORS

In this section I synthesize pedagogical vectors across the theories and raw pedagogical implications reviewed in the previous section. I refer to them as vectors because they represent general directions that might guide the development of a more specific pedagogy addressing the visual elements in informational texts. They are only an intermediary step, guiding the more specific work needed to develop curriculum and instruction useful to educators.

- Well-developed arguments (e.g., Multi-literacies and new literacies) support a press for systematic attention to literacy curricula and instruction aimed at developing the skills, strategies, and dispositions associated with creating and reading digital texts. These arguments are reinforced by calls from professional organizations (e.g., International Reading Association, 2009).
- Digital and printed texts are distinctly different media. Digital texts must be approached on their own terms, not as an online extension of printed text.
- Yet, comparing and contrasting the two media may be instructionally productive for identifying, characterizing, and understanding those differences. And, there is some overlap. For example, in both media, linguistic and visual elements can combine to increase memorability. General frameworks intended to guide the development and use of printed texts may, perhaps with some adaptation, be usefully applied to digital texts (e.g., functions of illustrations, see Duchastel, 1978; elements of good arguments, see Toulmin, 2003)
- A key difference between these two media is the role and affordances of visual representations. Visual representations often predominate in digital texts. They are not appropriately viewed as ancillary to the prose, as they are in printed texts. Unlike printed

texts and Warde's analogy of the crystal goblet, visual elements in digital texts are "looked at" not "looked through." Consequently, digital texts more naturally employ a visual rhetoric that is more perceptually concrete, rather than a philosophical rhetoric that is linguistically abstract.

- Decisions about using visual elements in digital texts must contend with a visual space that is at once constrained, and therefore contested (a single screen), but also infinite, multi-dimensional, and complex. Unlike the two-dimensions of a printed page, creating and navigating digital screens means contending with two additional dimensions: (a) simulated depth by layering textual space on a "desktop," and (b) time because decisions must be made about when visual information will be available and under what conditions.
- A strategic and effective use of visual elements interacts with unique structural affordances of digital texts. Specifically, digital texts are inherently interactive and structurally non-linear. Decisions about the use of visual elements must be orchestrated in relation to these structural affordances. For example, decisions must be made about the extent to which readers or the author/text control the visual display and/or under what conditions who is in control.
- Conventions that use visual elements in digital texts may need to be taught (e.g., blue words/phrases or a cursor that becomes a pointing finger signaling links, pull-down and popup menus). These are analogous to "concepts of print" that are foundational to learning to read printed text and taught, often informally, to young children (e.g., directionality of print) and later to older children (e.g., tables of contents and alphabetized indexes).

- Despite such conventions, digital texts are not formulaic, and they are less serious, inviting visual creativity, innovation, and experimentation. The visual and other affordances of digital texts (e.g., interactivity) encourage a “playfulness” that more naturally engages writers and readers. Digital texts are more akin to an artist creating multimedia artifacts than an artist using a single medium.
- However, this playfulness must be harnessed with an equal measure of disciplined purpose. The essence of reading is nurturing and maintaining a reflective and critical stance. Using visual effects gratuitously for their own sake--a greater temptation given the enhanced possibilities in digital environments--can undermine that essential stance. What can be done visually needs to give way to what should be done for the sake of understanding and reflective engagement. This principle is an extension of Warde’s analogy. If looking at digital texts is no more than a satisfaction of the need for perceptual immediacy or for entertainment, the visual is undermining the essential nature of reading, particularly in informational texts.

INSTANTIATING PEDAGOGICAL VECTORS IN CURRICULUM AND INSTRUCTION

A logical next step in seeking a pedagogy for visual elements in digital texts is to translate theory-based pedagogical vectors into specific curricular and instructional goals and ultimately into instructional activities to achieve those goals. These final steps are, in my judgment, virtually unaddressed in the literature but what teachers most need. They are certainly an unfinished educational endeavor for all aspects of teaching and learning about digital texts. Frameworks and tools are available for such a project, but they have not been used (see Wiggins & McTighe, 2005). Doing so, is far beyond the scope of this article. Instead, in this section, I try

to lay groundwork for such an effort. I identify challenges to developing curriculum and instruction that addresses the visual elements in informational texts; I provide a few examples of how those challenges might be addressed instructionally along with a few resources that are illustrative or potentially useful; and I summarize a study my colleagues and I conducted that illustrates how research might better delineate the challenges and how to address them.

One challenge is the difficulty of creating a curricular hierarchy of specific content, strategies, and skills, let alone how they might be embedded in a developmental sequence or spiral curriculum across grades. Some foundational knowledge and skills can be identified such as understanding and knowing how to use visual conventions to perform certain actions in digital texts (e.g. visual cues that signal links and pull-down menus). But, at what grade level should students most appropriately be introduced to those conventions? Can such conventions be distinguished from basic to advanced? (See an example for teachers created by Peggy Semingson:

https://docs.google.com/document/d/1CSRci1nl_LIEtXgUnAB9Gcf_hH_iH08xYIJz5OjAFb0/edit). There are also some general principles and dispositions that might be taught and continuously reinforced such as recognizing and avoiding gratuitous use of visual gimmicks. Warde's analogy might even be used to emphasize that principle, perhaps appropriately adapted for younger learners (e.g., a transparent or opaque fishbowl instead of a wine goblet).

However, there is a vast and diverse territory in between foundational conventions and general principles. And, in digital texts, the almost limitless range of visual options, their complex relation with prose and the display space available, and a valuing of innovative and creative visual presentations, all work against any narrow and specific guidelines, although some rules of thumb based might be developed and taught. Compared to printed texts, the use of

visual elements in digital texts is more subjective and open for discussion. But, that realization may be an important insight for instruction. Teaching standard rules or frameworks within accepted genres of print would give way to subjective analysis, discussion, and constructive debate about the use and effectiveness of visual elements in conveying information effectively. For example, the organization of a published research report in print and rules for citation might arguably be unnecessary, even counterproductive, in a digital form (e.g., direct links to cited sources). Teachers and students might engage in addressing questions such as: How and for what purposes are the visual elements in a particular digital text being used? What opportunities to productively use visual elements were apparently ignored or lost? What might this digital text look like if it were only available in printed form? How would you re-design or enhance visually the text to be more effective in communicating information? Students might also be engaged in activities that allow them to discuss personal strategies for accessing and using visual information in existing instructional frameworks such as reciprocal teaching (Brown & Palinscar, 1987).

Discussing these and similar questions could naturally segue into the theory-inspired pedagogical vectors in the previous section. Teaching the role of visual elements in digital texts may mean raising awareness and developing sensitivities more than teaching established, set forms and strategies. Fortunately, there is no shortage of resources and examples online (see Table 1). On the other hand, systematic instructional activities may be needed to address more nuanced and less intuitive concepts such as the differences between printed and digital texts in their rhetorical focus, structure, and dimensionality. Such content and activities might be appropriately relegated to the high-school or college-level curriculum. Some frameworks that apply to both printed and digital texts may also be instructionally useful. For example,

Duchastel's three purposes for illustrations (attentional, explicative, and retentional) is a simple framework that might also be applied to digital texts, with teachers challenging their students to expand that framework to accommodate the greater diversity of possibilities and uses in digital texts.

Table 1. Online resources and examples

Teaching about visualization in digital texts

- PowerPoint as a digital story telling tool, by a teacher for teachers:
https://www.youtube.com/watch?v=OC1OixM_118
- "Periodic Table" classifying Visualization techniques with pop-up examples:
http://www.visual-literacy.org/periodic_table/periodic_table.html
- A graduated framework (easy-to-advanced) for teachers who want to involve their students in digital forms of communication:
https://docs.google.com/document/d/1CSRci1nL_LIEtXgUnAB9Gcf_hH_iH08xYIJz5OjAFb0/edit Links to online resources provided.

Tools for creating visual content

- Gapminder. free teaching resources making the world understandable based on reliable statistics and addressing misconceptions: <https://www.gapminder.org/about-gapminder/>
- Digital scholarship lab at the University of Richmond.
<http://dsl.richmond.edu/index.html#hero>
- Digital Humanities Tools:
<http://dhresourcesforprojectbuilding.pbworks.com/w/page/69244319/Digital%20Humanities%20Tools> Click on "visualization tools."
- Visual thesaurus. Visual representation of word meanings and relationships:
<https://www.visualthesaurus.com/?vt>
- Wild fonts ("looking at the gold cup"/alphanumeric code as a visual element):
<https://www.dafont.com/theme.php?cat=202>

Infographics, interactive graphics, and data visualization

Resources

- Information is beautiful. Twitter feed on data visualization:
<https://twitter.com/infobeautiful> See also: <https://informationisbeautiful>
- "Word Clouds" showing which words appear most often in a text:
<http://www.wordle.net/>
- The visual everything. Infographics:
<http://www.thevisualeverything.com/category/infographic/>

- Google ngrams. Info graphics and trends in uses of words and phrases:
<https://books.google.com/ngrams>

Examples With Connections to Current Events and Social Studies

- Real time data visualization. Tweets around the world: <https://www.tweetping.net/#/>
- The American Values Atlas. Interactive info graphic: <http://ava.ppri.org/home>
- Animated time line of American voting patterns:
<http://www.americanpast.org/voting/presvoting.html>
- Interactive time line of the Arab Spring:
<https://www.theguardian.com/world/interactive/2011/mar/22/middle-east-protest-interactive-timeline>
- Tracking how fast American's change their minds about issues:
https://www.bloomberg.com/graphics/2015-pace-of-social-change/?utm_campaign=Brookings+Brief&utm_source=hs_email&utm_medium=email&utm_content=17438951&hsenc=p2ANqtz-tSb-L7nDQnm6rh0a-LeAuPTXk37xFyBxABMjWLBIdPlcqZz46LwwVjKe4RzJ7zCEjNvlpUnmHOHzRD8o8H1b8NPGNAQ&hsmi=17438951

Another available and potentially useful framework for static graphics, and thus applicable to printed and digital text, is inspired by the periodic table in chemistry (see http://www.visual-literacy.org/periodic_table/periodic_table.html#). It provides general and specific categories with pop-up examples and is an interesting example in its own right of using metaphors and analogies to represent graphical information. Students might add examples of more dynamic and interactive representations of data and processes in the table's existing categories or create new categories, thus highlighting the unique structural and interactive characteristics of digital texts.

Certainly, one major category that has become a recognized genre of data visualization in digital texts is infographics. Arguably, infographics are the quintessential example of how powerful and central visual representations are in digital expository texts. Not only can infographics make divergent information clear in a memorable form, they can show complex and interesting relations (occasionally, additively so) among data not easily, and sometimes impossibly, represented in linguistic form. They are a clear example of digital texts employing a

symbol system that can expand the representable, while easing the cognitive burden of extracting relevant information. From an educational perspective, they also represent a bridge between literacy and other curricular and disciplinary subjects. Infographics can be taught as useful tools in the literacy curriculum (e.g., “Word Clouds” such as Wordle <http://www.wordle.net/> Google’s N-gram <https://books.google.com/ngrams> and the Visual Thesaurus <https://www.visualthesaurus.com/?vt> . However, they can also make content come alive in other disciplines by powerfully engaging students in critical reading, informed speculation, and further research, sometimes generated by unexpected relations among diverse data. For example, students in a social studies or history class might be shown an infographic tracking voting patterns by political party for presidential elections from 1840-2008 (<http://www.americanpast.org/voting/presvoting.html> see Table 1 for more examples). They could be challenged to list some speculative generalizations and then to gather information that supports or negates them or to explain the visual pattern in a particular election or time frame. Or, they could be asked to develop, and perhaps execute, an idea for an infographic that would help explain their findings.

Such curricular and instructional topics, content, and activities related to the visual elements of digital texts await further development, perhaps informed by the theories and related pedagogical vectors noted here. But there are other challenges. A major one is how conventional literacy instruction can be transformed to accommodate those new goals and activities. There are empirical data that provide both good news and not-so-good news in that regard. From a national survey (Hutchison & Reinking, 2011), it is clear that literacy teachers in general understand and accept that literacy is changing and that there is a need to address that change. The not-so-good news is that they see needed change more in terms of technological

integration (i.e., bringing new technologies into the classroom) rather than curricular integration (i.e., adopting new instructional goals, content, and activities). Further, in-service professional development for teachers has been found to reinforce a more superficial focus on using new technological applications (Lawless & Pellegrino, 2007). In the aforementioned survey, teachers also identified many obstacles to more fully integrating new digital forms of literacy into their instruction and most of these obstacles were external to their classrooms and beyond their control (see Hutchison & Reinking, 2010), suggesting a lack of necessary support from policy makers, curriculum designers, and administrators. The most-often identified obstacle, perhaps unsurprisingly, was time to engage with new technologies and to revise their teaching accordingly.

Regrettably, researchers have provided little help in addressing these challenges, which itself becomes a challenge. They have served mostly to point out that literacy is changing, to argue that the content of literacy instruction needs to adapt accordingly, to document difficulties and obstacles (e.g., see the previous paragraph), to investigate the effectiveness of a few ad hoc, isolated (i.e., from any curricular planning or concerns) classroom activities that teachers might try, to engage in abstract theorizing, and, perhaps ironically, to develop assessments of skills for which there is no systematic, widely used or agreed-upon instruction to develop (e.g., Kiili, et al., 2018). What they have not done is help translate their perspectives and theories into a systematic pedagogy. They leave policy makers and practitioners to work out the details, which, as Grossen (1996) pointed out, is like asking doctors to invent their own drugs. Little has changed since that observation more than 20 years ago. For example, Catherine Snow (2015), whose credentials include serving as president of the American Educational Research Association, has described education research as “feckless” needing closer connections and relevance to practice. What is

needed is research that reveals the conditions under which authentic transformation of curriculum and instruction can occur. Such research would include identifying what conditions enhance or inhibit such a transformation and would move beyond an exclusive focus on effectiveness, as determined by readily measured skills, to include practical efficiency and appeal (to teachers and students). It would also provide explicit guidance for practitioners about how interventions might be implemented to achieve specific instructional goals ideally embedded in thoughtfully constructed curricular frames.

My former students and I have taken small steps, given the enormity of the challenge, toward conducting such research (Colwell, Hunt-Baron, & Reinking, 2013; Colwell & Reinking, 2016; Howell, 2017; Howell, Butler, & Reinking, 2017) and to provide suggestions and advice for practitioners (e.g., Colwell, Hutchison, & Reinking, 2012; Howell & Reinking, 2015; Howell, Reinking, & Kaminski, 2015). In our research, we use formative experiments (Reinking & Bradley 2008) a methodological approach aimed at generating insights and pedagogical theories useful to designing and implementing instructional interventions. Formative experiments, conducted in strategically selected classrooms, study how instructional interventions grounded in theory and empirical research can be implemented to achieve specific, valued instructional goals. The intervention is formatively modified based on collecting data to determine what conditions enhance or inhibit progress toward the pedagogical goal. Unanticipated outcomes (positive and negative) are noted, as are teachers' and students' reactions (e.g., embracing or resisting) to content and instructional moves. Overall, that process reveals deep pedagogical understanding that take the form of pedagogical assertions and eventually theories for teaching. We learn much about the intervention and its interaction with

the factors operating in real classrooms, but also about the content, about the human dimension of teaching and learning, and so forth.

In one study (Howell, Butler, & Reinking, 2016; see also Howell, 2017) we investigated the integration of multi-modal texts into the conventional high school writing curriculum. The pedagogical goal was to enhance students' ability to construct good arguments, both in writing conventional texts and in designing multimodal digital texts. Although the focus was on achieving that pedagogical goal, we learned much that would inform efforts to create curriculum and instruction concerning the visual elements of digital texts. For example, we documented a teacher's palpable discomfort in using the intervention in a class of students who she felt pressured to prepare for a standardized exam focused on writing conventional arguments. Even though, the goal was to improve argumentative writing in both media, she legitimately saw working with digital media as unproven and risky.

Consequently, we suggested moving the intervention to a lower-level class of students, not immediately facing that exam. This development illustrates well the not surprisingly intimate relationship between curriculum, instruction, and high stakes assessment. Teachers may be more open and enthusiastically engaged in teaching the visual elements of digital texts when high-stakes assessment is not imminent, when there are specific efforts to link new knowledge and skills to conventional assessments, or ideally when curriculum and assessments are closely linked to include digital texts. There is important movement toward realizing the latter condition in the Common Core State Standards, which, consequently, offers an important opening for advancing instruction aimed at attending to digital texts in general and their visual elements in particular.

Other findings in our study also produced useful pedagogical insights. For example, we found that the teachers' not uncommon commitment to a process approach to writing undergirded and sustained her commitment to engaging her students in creating multimodal arguments. We also found that despite students' facility with popular uses of digital technologies, particularly social media, they were notably inept at using basic digital functions and tools (e.g., copying and pasting; Internet searches) for academic purposes. I believe that such insights highlight what is necessary to create a realistic and workable pedagogy that addresses the visual elements of digital texts. And, it illustrates the inadequacies of the current research base and what kind of research is needed to expand, and perhaps to replace, it.

SHATTERING THE CRYSTAL GOBLET

Warde's analogy of a gold chalice and a crystal goblet succinctly and memorably reflects two fundamental and necessary aspects of engaging with informational texts. First, engaging with texts always entails some form of perception, most typically visual. Second, the fundamental purpose of engaging with informational texts is inner enlightenment characterized by a reflective and a critical stance that must not be overwhelmed or dimmed by the perceptual experience. In this sense, her analogy remains viable and useful. Yet, Warde lived in a typographic era during which a linguistic symbol system, encapsulated in print, occupied center stage with other visual representations playing a supporting role.

In that era, writing the prototypical informational text typically began with a conceptual, or actual, outline of a hierarchical structure for a linguistic presentation. Using other graphical representations typically arose while instantiating that outline, perhaps suggested by a reviewer, editor, or professional illustrator. That a text using the alphanumeric code was actually a visual representation was typically subliminal for writers as well as their readers. In fact, conventional

reading instruction for young children, in one sense, means developing precisely the condition Warde advocates. We teach children to overcome the unskilled attention to letters and words, and instead to look transparently through them. Beginning reading instruction is, in one sense, replacing the gold cup with the crystal goblet.

Matters are decidedly different in a post-typographic era when digital texts prevail. The diverse and dynamic technological affordances and enhanced symbol systems of digital media move visuality to center stage, in some instances relegating linguistic information to a supportive role, much as they do in children's picture books. Online texts that look essentially like printed texts, with no visual clues for links and only static graphics increasingly look like lost orphans from another era. This shift in position shatters the crystal goblet analogy. We cannot avoid looking at, not through, the visual elements of digital texts. And, creating or reading them, reverts not to the opaque golden cup, but instead becomes looking at the shattered pieces and trying to assemble them creatively into a goblet that remains transparent but also meaningful and aesthetically pleasing in its own right.

Helping people become fully literate today cannot ignore this shift. Certainly, educators must accept the responsibility of engaging their students fully in a realistic literacy of a post-typographic world. But, they cannot, nor should they be expected, to do it alone. They need explicit guidance and assistance, not cheerleaders or fans observing from a distance, let alone scolds who fault them for not getting on board with a changing literacy. They need the support of curriculum developers, for example in state offices of education. They need the support of district- and building-level administrators in creating time and space, literally and figuratively, for them to adapt their instruction accordingly. They need researchers to move beyond abstract theorizing, beyond preaching the need for change, and beyond conducting research that results in

little explicit guidance for how curriculum and instruction can be meaningfully and practically transformed. This article was motivated to modestly move in that direction.

Finally, on a personal note, I find that my awareness of digital texts' visual dimensions and the effort (or lack thereof) by authors to use visual elements effectively enlarges a reflective and critical stance that is intermingled with my attention to the content. Visuality now seems embedded in my consciousness across the full landscape of my literate experience. For example, I notice how an online interactive infographic tells a story in a way that would be difficult, if not impossible, to portray linguistically, and about its powerful instructional possibilities, which makes me long to be back in the classroom—I'm still a teacher at heart. I contemplate the rise and role of emoticons and iconic messages on signs along roads that communicate with a visual economy that alphanumeric symbols cannot. I still receive and read National Geographic in printed form and wonder if it was a precursor of digital texts' heightened visuality, and what it would look like, and what would be lost, without its engaging photographs and skillfully developed and creatively designed maps, figures, and graphs. I wonder if there is a good reason that an author writing the following sentence in a printed text, "She is small and fair with delicate features." didn't include a picture, and maybe if there is some advantage in not having one. I pause in my quest for information to appreciate a particularly well-done, effective, or creative use of a visual representation at a website. I'm not sure Warde would approve of this "looking at" instead of "through" such texts. But, if it were possible to ask her, I hope that she would acknowledge that all analogies breakdown at some point and that changing conditions mean reinterpreting or replacing them.

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